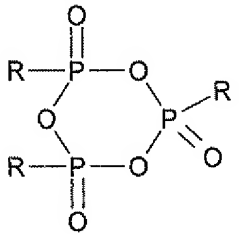
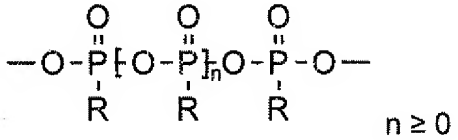
Claims

1. A proton-conducting polymer membrane based on polyazoles which can be obtained by a process comprising the steps of
   A) dissolving the polyazol-polymer in organic phosphonic anhydrides with formation of a solution and/or dispersion,
   B) heating the solution obtainable in accordance with step A) under inert gas to temperatures of up to 400°C, preferably up to 350°C, particularly of up to 300°C,
   C) forming a membrane using the solution of the polyazole polymer in accordance with step B) on a support and
   D) treatment of the membrane formed in step C) until it is self-supporting.

2. The membrane according to claim 1, characterized in that, in step A), organic phosphonic anhydrides of the formula

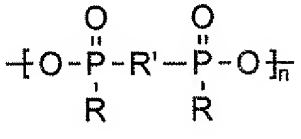


or linear compounds of the formula



n ≥ 0

or anhydrides of the multiple organic phosphonic acids of the formula



n≥1

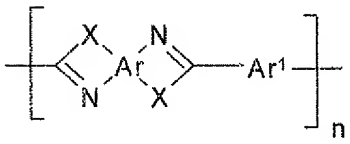
wherein the radicals R and R' are identical or different and represent a C_1-C_{20} carbon-containing group.

3. The membrane according to claim 1, characterized in that, in step A), a polyphosphoric acid having a content of at least 83%, calculated as P_2O_5 (by acidimetry), is additionally used.

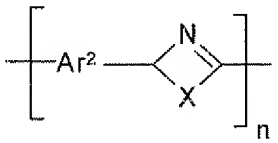
4. The membrane according to claim 1 or claim 9, characterized in that, in step A), P_2O_5 is additionally used.

5. The membrane according to claim 1, characterized in that, in step A), B) or step C), a solution or a dispersion/suspension is produced.

6. The membrane according to claim 1, characterized in that, the polymer used in step A) contains recurring azole units of the general formula (I) and/or (II) wherein



(I)



(II)

Ar are identical or different and represent a tetracovalent aromatic or heteroaromatic group which can be mononuclear or polynuclear,

Ar^1 are identical or different and represent a bicovalent aromatic or heteroaromatic group which can be mononuclear or polynuclear,

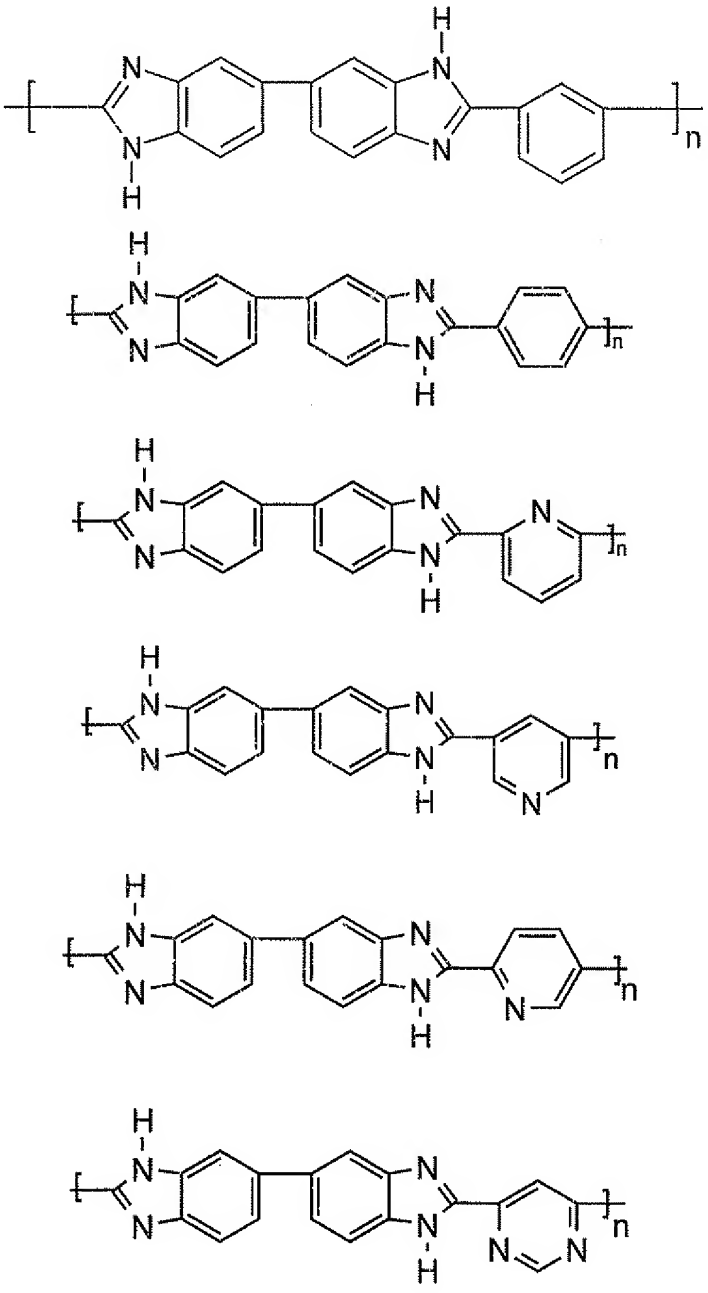
Ar^2 are identical or different and represent a bicovalent or tricovalent aromatic or heteroaromatic group which can be mononuclear or polynuclear,

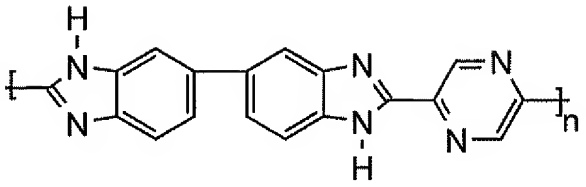
X are identical or different and represent oxygen, sulphur or an amino group which carries a hydrogen atom, a group having 1 - 20 carbon atoms, preferably a branched or unbranched alkyl or alkoxy group, or an aryl group as a further radical.

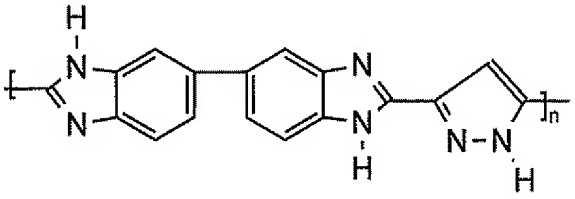
7. The membrane according to claim 1, characterized in that, in step A), a polymer selected from the group consisting of polybenzimidazole, poly(pyridines), poly(pyrimidines), polyimidazoles, polybenzothiazoles, polybenzoxazoles,

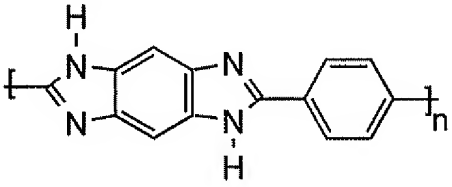
polyoxadiazoles, polyquinoxalines, polythiadiazoles and poly(tetrazapyrenes) is used.

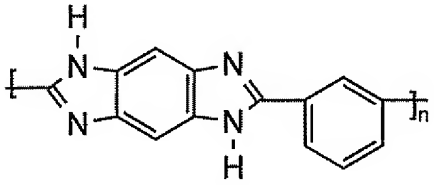
8. The membrane according to claim 1, characterized in that, in step A), the polymer used contains one or more recurring benzimidazole units of the formula

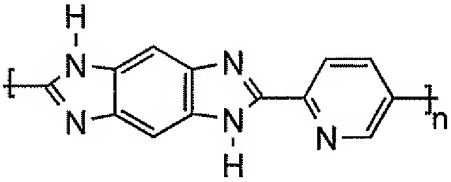


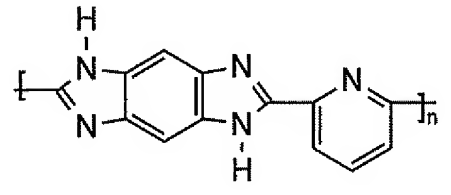


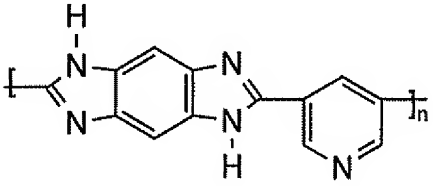


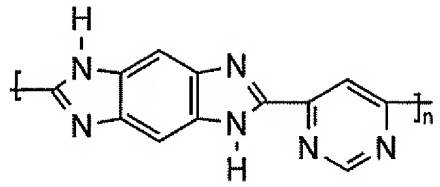


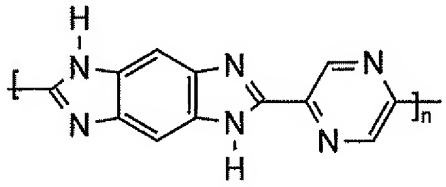


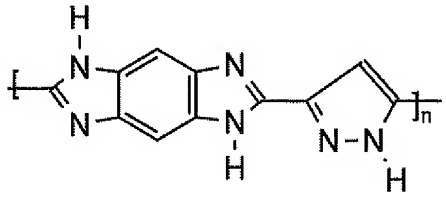


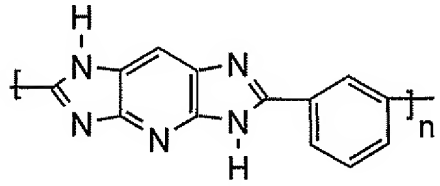


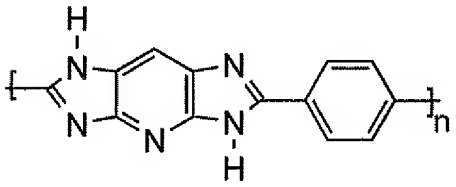


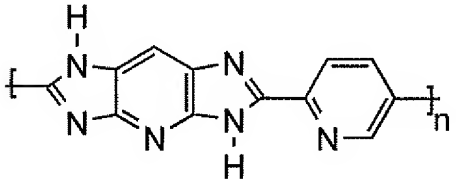


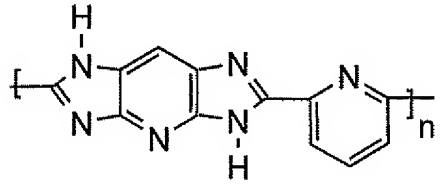


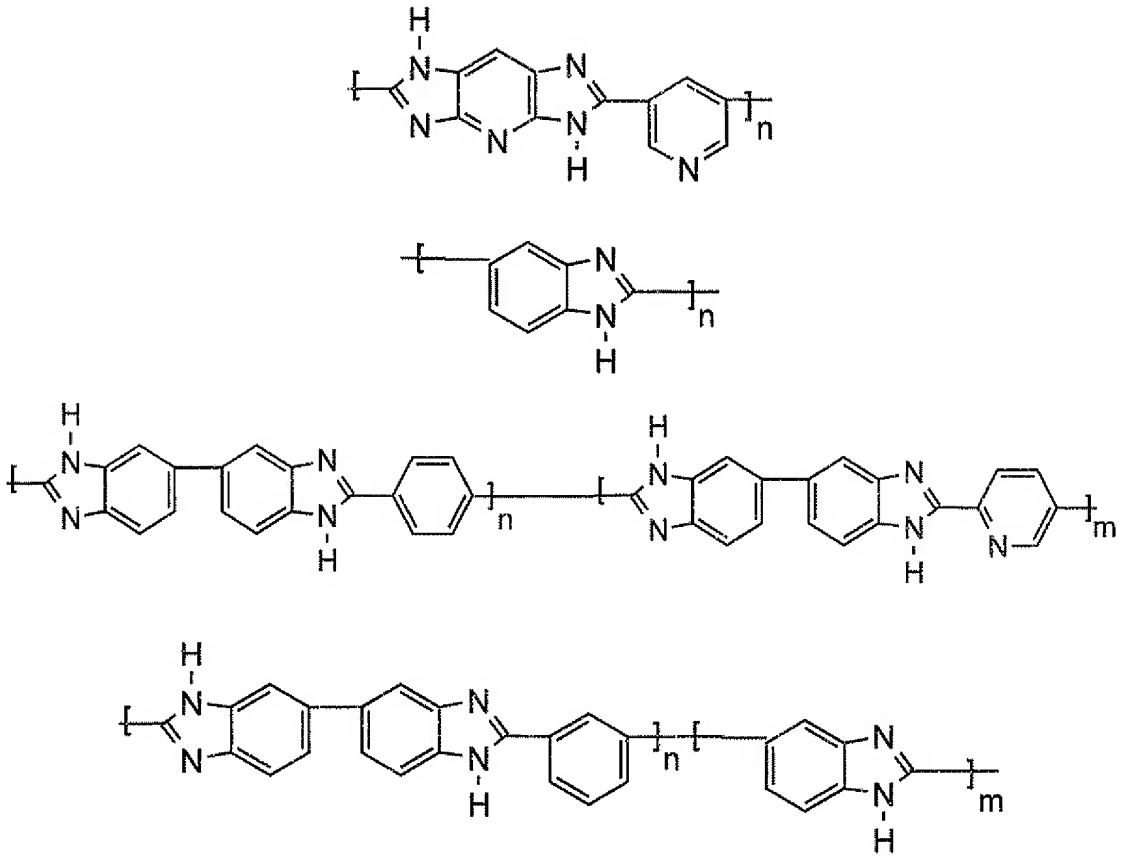












where n is an integer greater than or equal to 10, preferably greater than or equal to 100.

9. The membrane according to claim 1, characterized in that, before, during or after step A) and/other step B) or before step C), a further polymer is added as blend material.

10. The membrane according to claim 1, characterized in that, before step D), the viscosity is adjusted by addition of phosphoric acid and/or organophosphonic acids.

11. The membrane according to claim 1, characterized in that the membrane produced in accordance with step C) is treated in the presence of moisture at temperatures and for a period of time until the membrane is self-supporting and can be detached from the support without any damage.

12. The membrane according to claim 1, characterized in that the treatment of the membrane in step D) is performed at temperatures of more than 0°C and less

than 150°C, preferably at temperatures between 10°C and 120°C, in particular between room temperature (20°C) and 90°C, in the presence of moisture or water and/or steam.

13. The membrane according to claim 1, characterized in that the treatment of the membrane in step D) is for 10 seconds to 300 hours, preferably 1 minute to 200 hours.

14. The membrane according to claim 1, characterized in that, in step C), an electrode is chosen as the support and the treatment in accordance with step D) is such that the membrane formed is no longer self-supporting.

15. The membrane according to claim 1, characterized in that, in step C), a layer having a thickness of 20 to 4000 µm, preferably between 30 and 3500 µm, in particular between 50 and 3000 µm, is produced.

16. The membrane according to claim 1, characterized in that the membrane formed in step D) has a thickness between 15 and 3000 µm, preferably between 20 and 2000 µm, in particular between 20 and 1500 µm.

17. An electrode having a proton-conducting polymer coating based on polyazoles which can be obtained by a process comprising the steps of
    A) dissolving the polyazol-polymer in organic phosphonic anhydrides with formation of a solution and/or dispersion,
    B) heating the solution obtainable in accordance with step A) under inert gas to temperatures of up to 400°C, preferably up to 350°C, particularly of up to 300°C,
    C) forming a membrane using the solution of the polyazole polymer in accordance with step B) on an electrode and
    D) treatment of the layer formed in step C).

18. The electrode according to claim 17 where the coating has a thickness between 2 and 3000 µm, preferably between 3 and 2000 µm, in particular between 5 and 1500 µm.

19. A membrane electrode unit containing at least one electrode and at least one membrane according to one or more of claims 1 to 16.

20. The membrane electrode unit containing at least one electrode according to claim 17 or claim 18 and at least one membrane according to one or more of claims 1 to 16.

21. A fuel cell containing one or more membrane electrode units according to claim 19 or claim 20.